

ICRR INTER-UNIVERSITY AWARD TELESCOPE ARRAY



**John Matthews - University of Utah
Telescope Array Collaboration**

29 January 2025

TELESCOPE ARRAY

Telescope Array Detectors

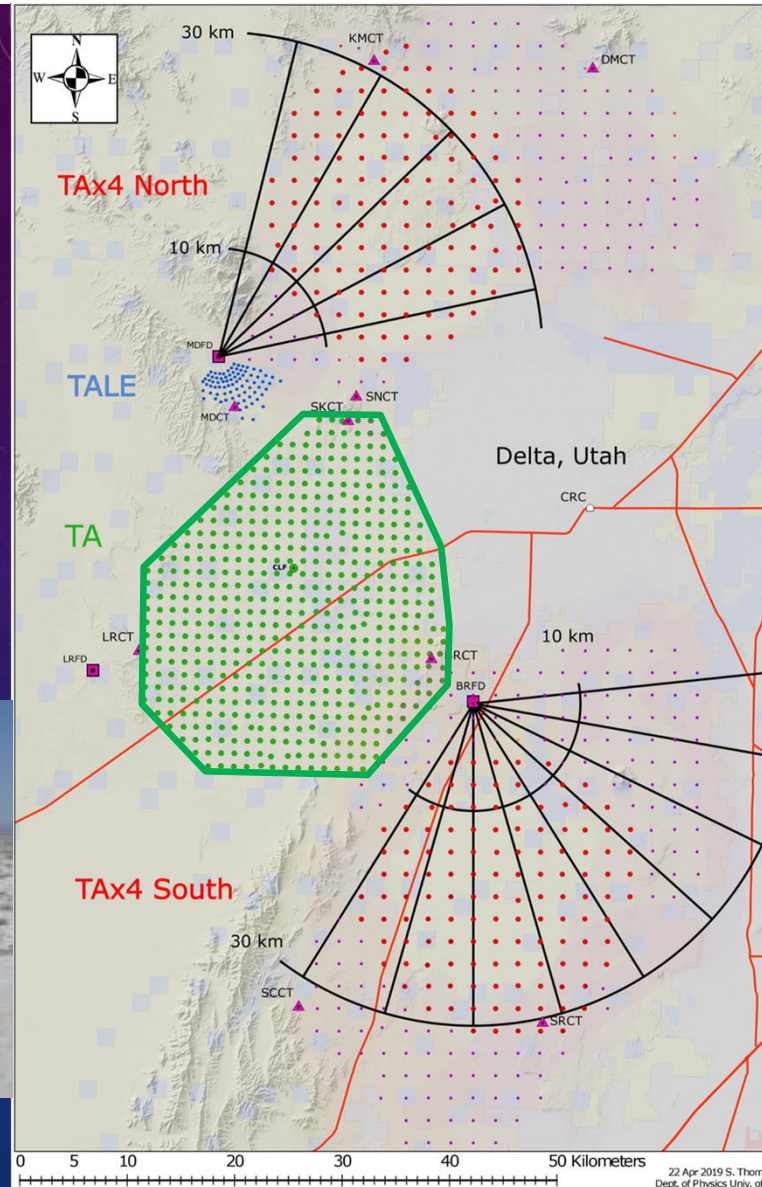
Surface Detector Array (3/2008)

- 507 Scintillator Counters
- 3 m² area
- 1.2 km spacing
- ~700 km²

Fluorescence Telescopes (2007)

- 3 Stations
- 12–14 Telescopes ea
- 3°–31° elevation
- FOV above SD Array

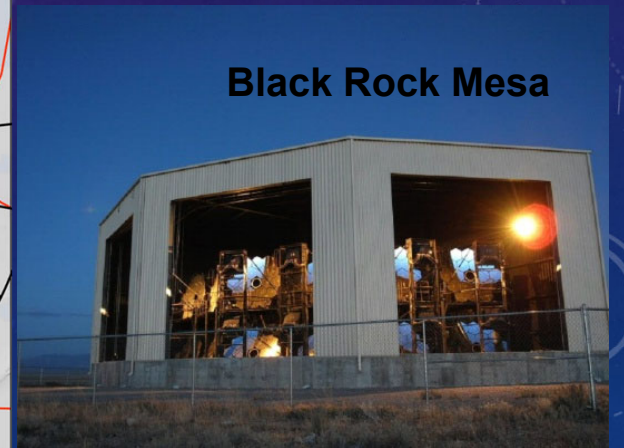
Scintillator Detector



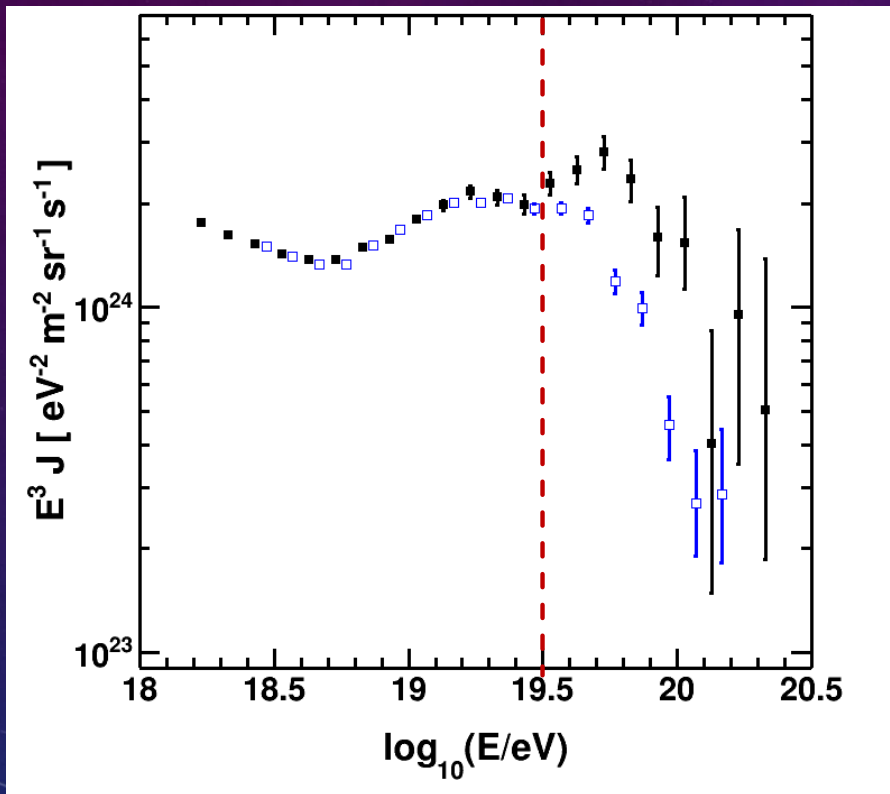
Middle Drum



Black Rock Mesa

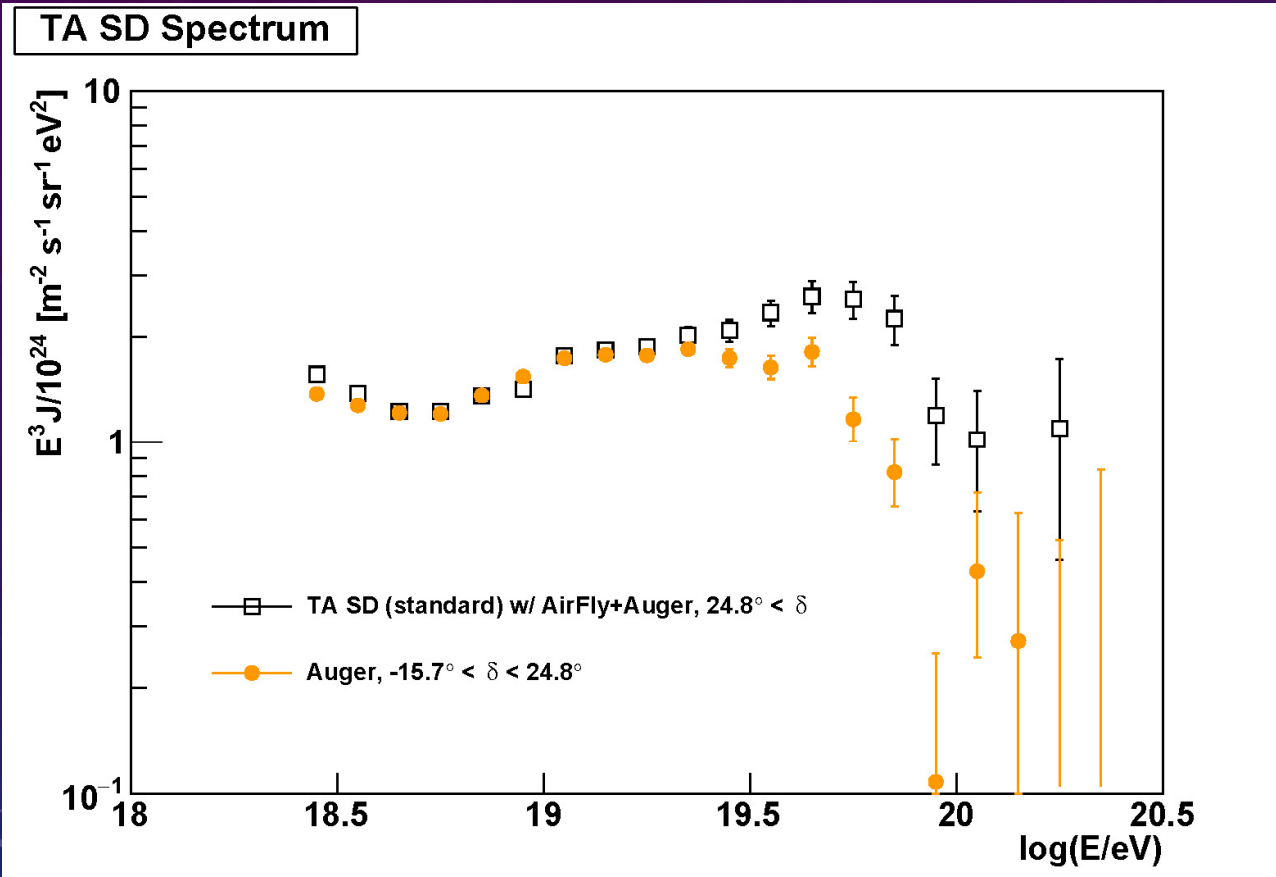


THE TELESCOPE ARRAY AND AUGER SPECTRA



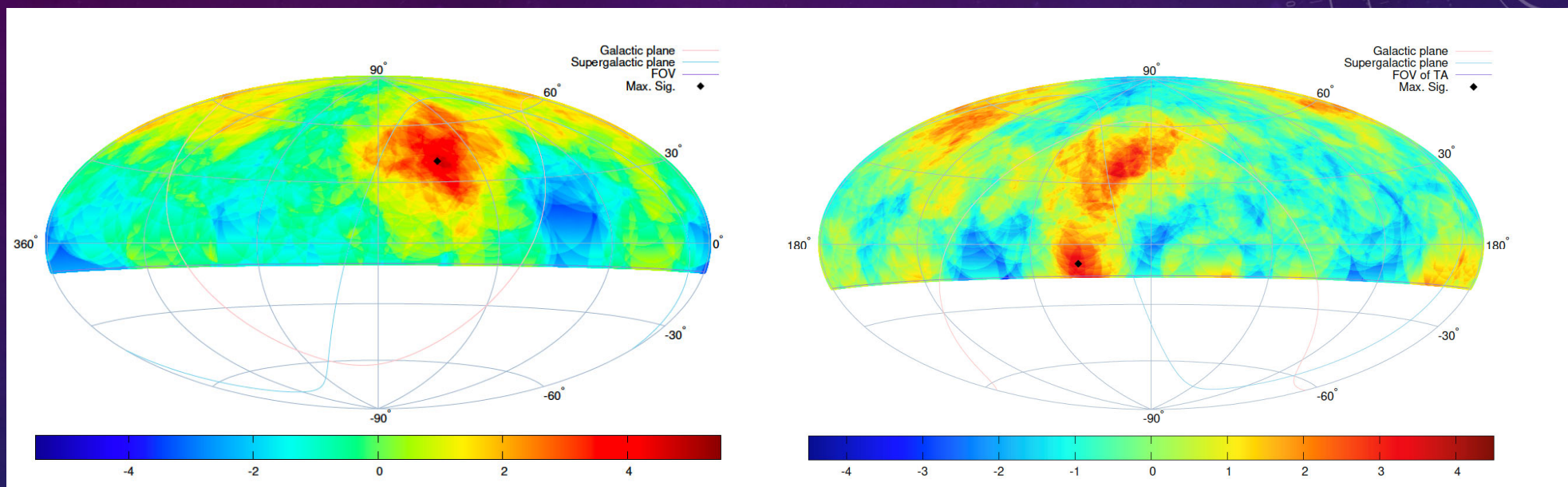
- The spectrum difference between TA and Auger has long been a source of controversy – there was a $\sim 9\%$ difference in the normalization
- Shifting one or the other or both the spectra could be made to mostly agree
- **However, a significant energy difference persists at $E > 10^{19.5} \text{ eV}$**

ASSUMPTIONS ARE PART OF THE DIFFERENCE



- Demonstrated by K.Fujita and S.Ogio at the Nagoya ICRC-2023
- If Telescope Array uses the fluorescence yield and missing energy corrections as Auger assumes, it brings the spectra into agreement for $E < 10^{19.5} \text{ eV}$
- Common View Declination Band -15.7° to $+24.8^\circ$

ANISOTROPY SIGNAL/EXCESS REGIONS IN TA DATA (14 YRS)

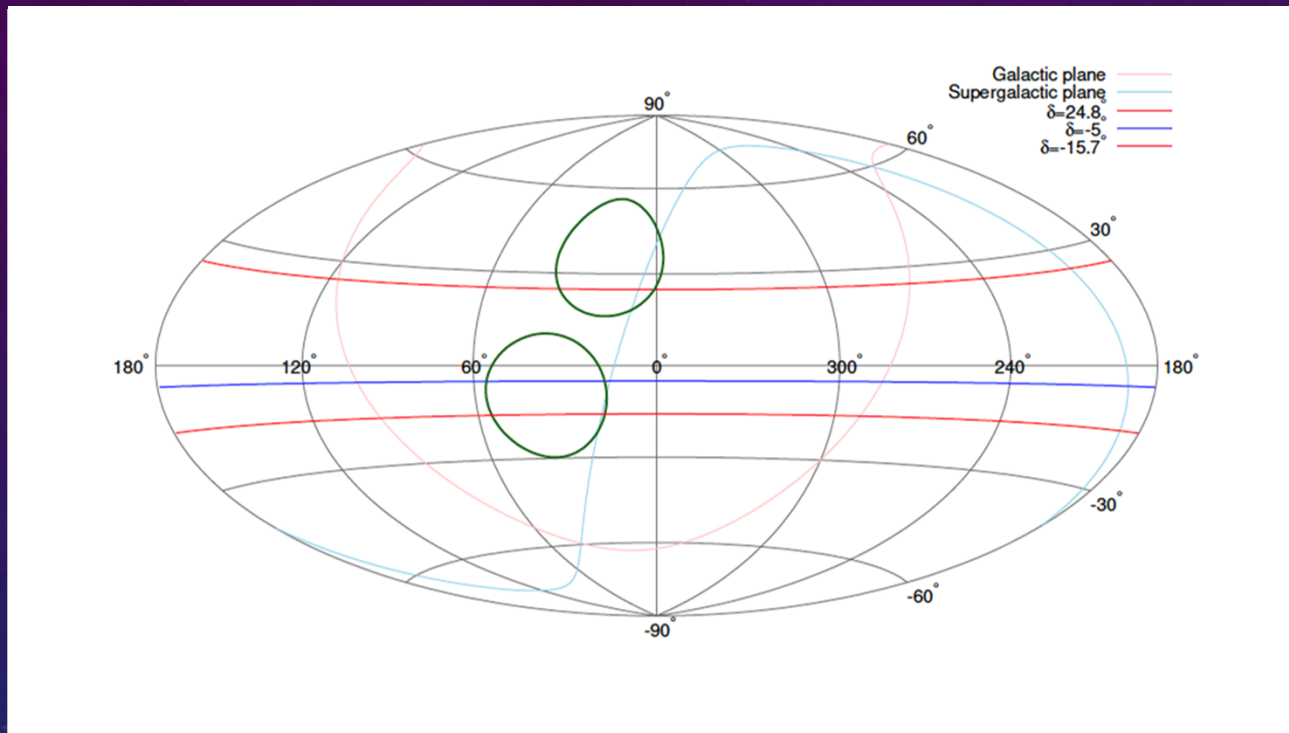


TA Hotspot
 $E > 10^{19.75}$ eV
 3.2σ post-trial

Perseus-Pisces SC
 $E > 10^{19.6}$ eV
 3.5σ post-trial

NGC 1068
 $E > 10^{19.6}$ eV
 3.7σ post-trial

THE AUGER FOV OBSERVES *PORTIONS* OF THE SKY WITH TA EXCESSES BUT SEES NO SIGN OF EXCESS IN ANY OF THEM

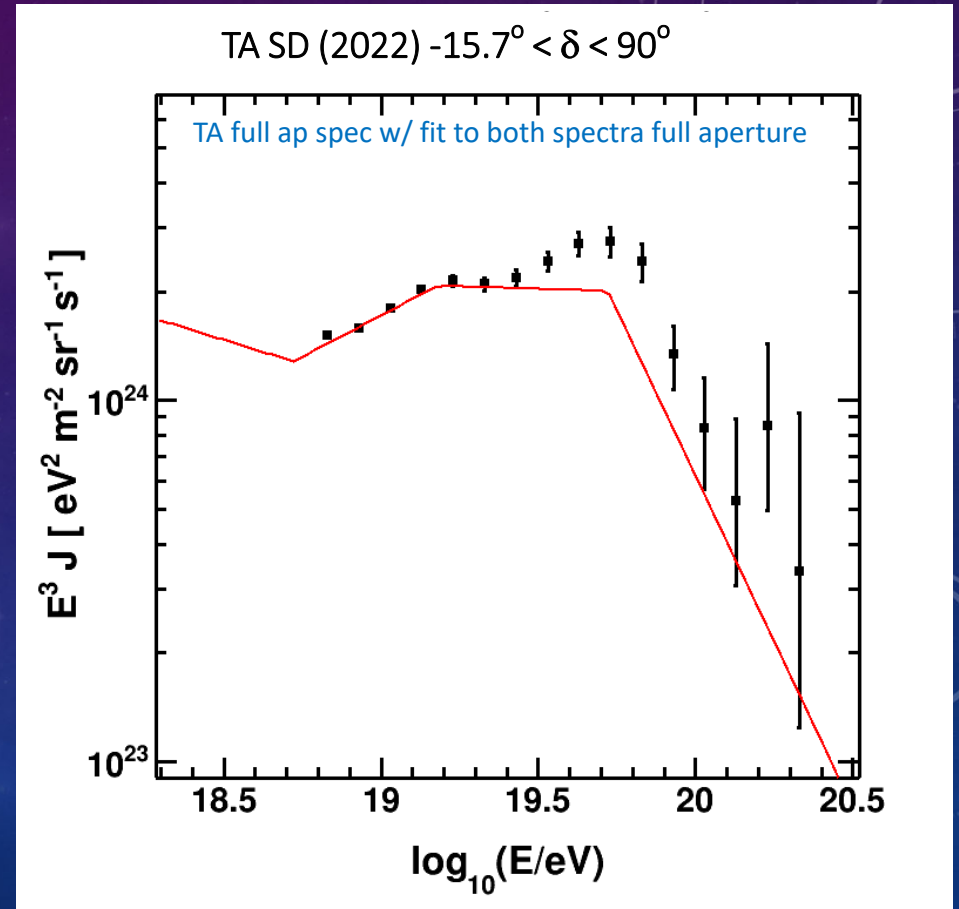
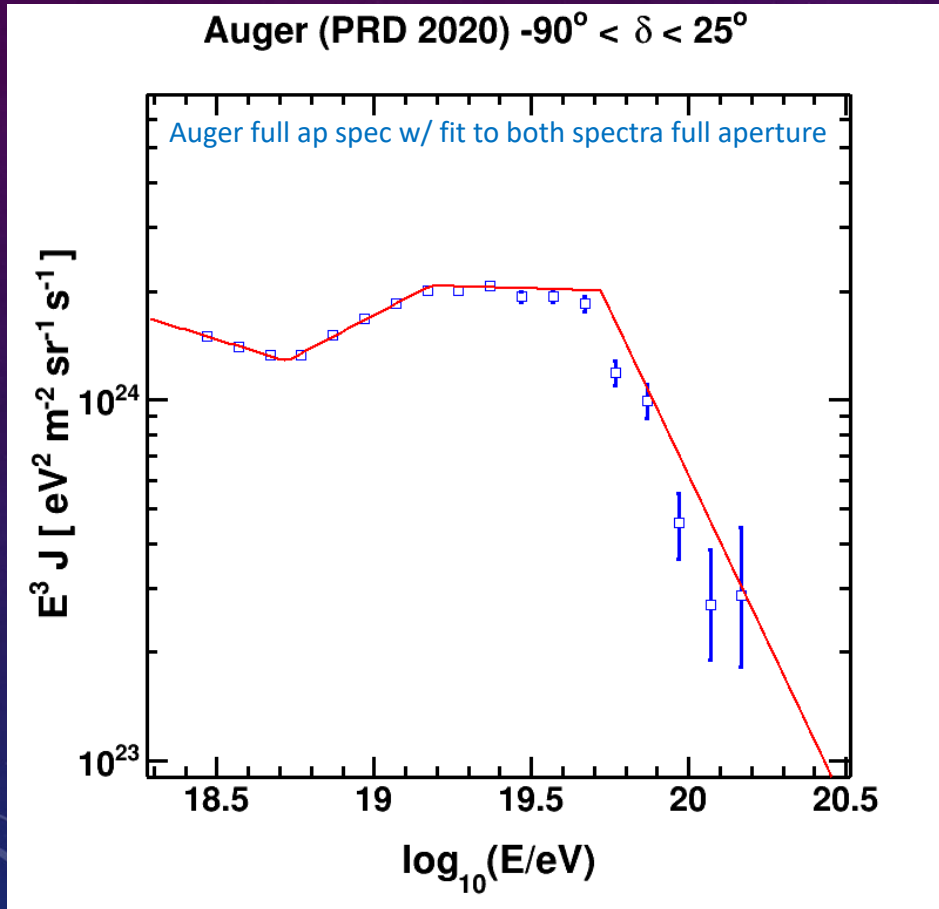


- Auger Data Observes
- TA HotSpot at -1.0σ
- Perseus-Pisces at $+0.1\sigma$
- Auger does NOT see the whole HotSpot or PPSC region
- Is the Telescope Array HotSpot (or any of these) a real source?
- Testing this is the main reason for building TAx4

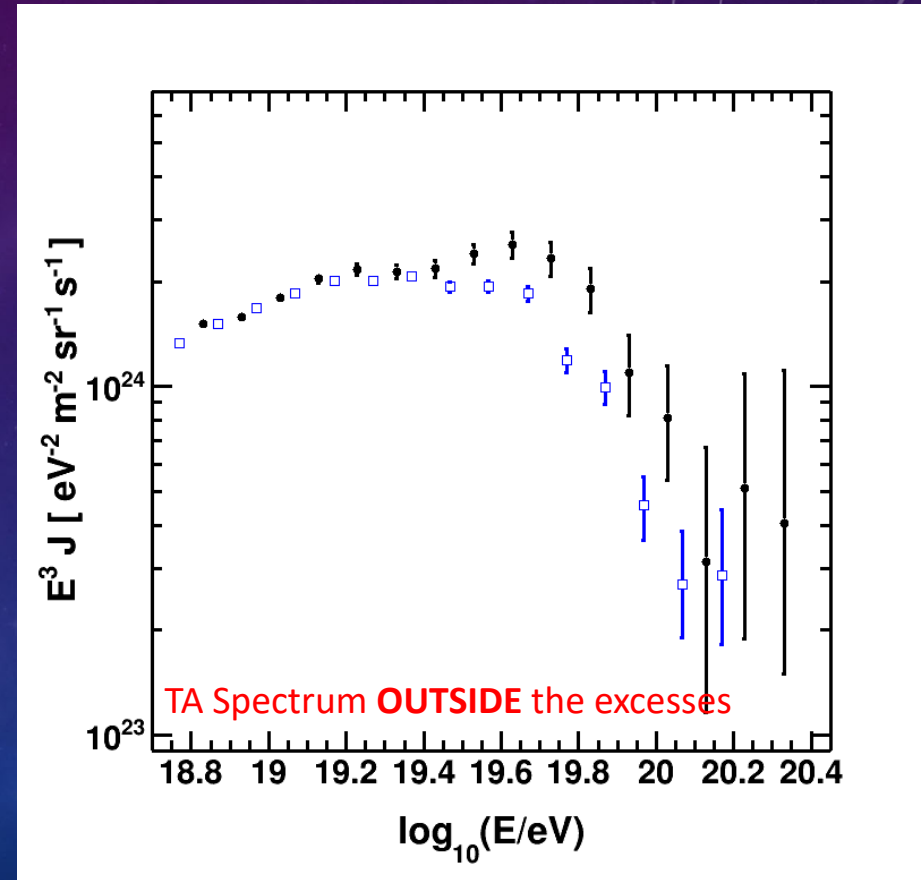
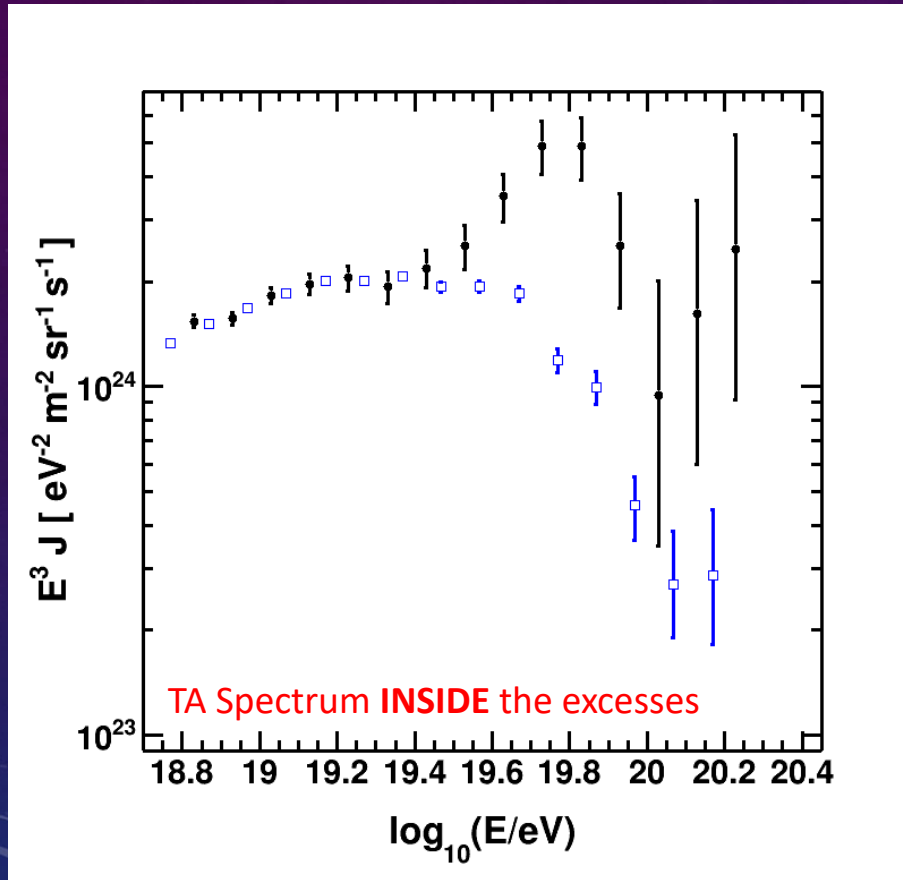
Auger 17 yrs
 $E > 32 \text{ EeV } (\sim 10^{19.5} \text{ eV})$

The red line is the same fit function.

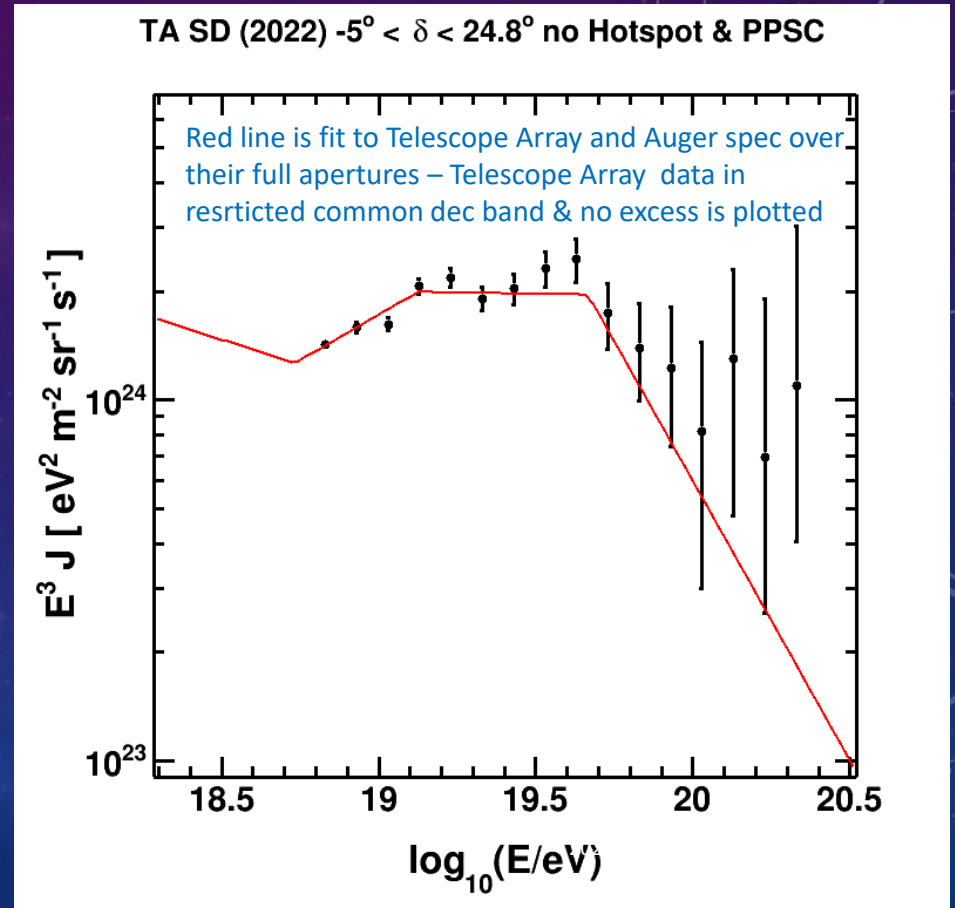
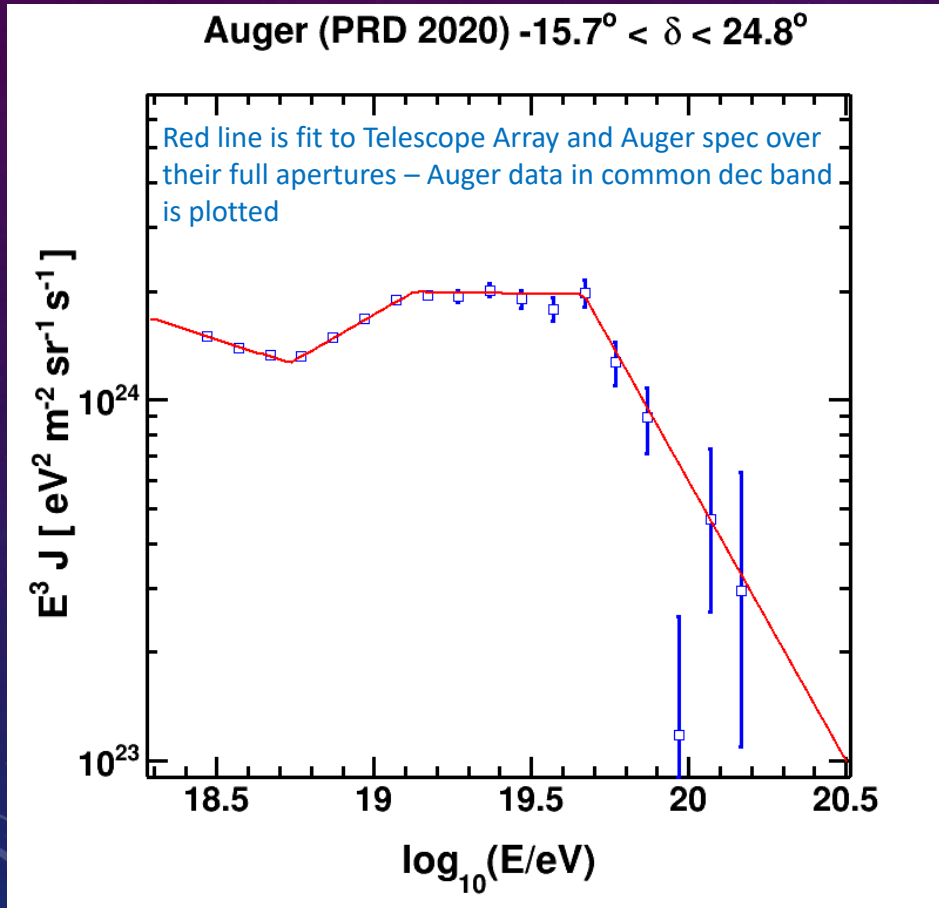
FITTING BOTH SPECTRA IN THEIR FULL APERTURES: 8.0σ DIFFERENCE



MEANWHILE:



FITTING BOTH SPECTRA, TA $-5^\circ \leq \delta < 24.8^\circ$ & EXCL. HOTSPOT + PPSC: 1.8σ

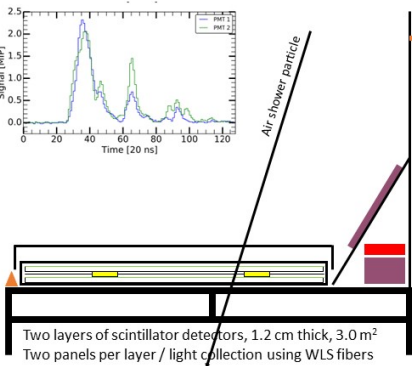
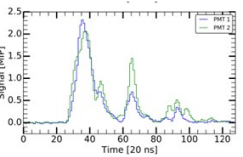


TELESCOPE ARRAY ALSO HOSTS A MINI-AUGER ARRAY

The Surface Detector, the statistical engine of both experimen

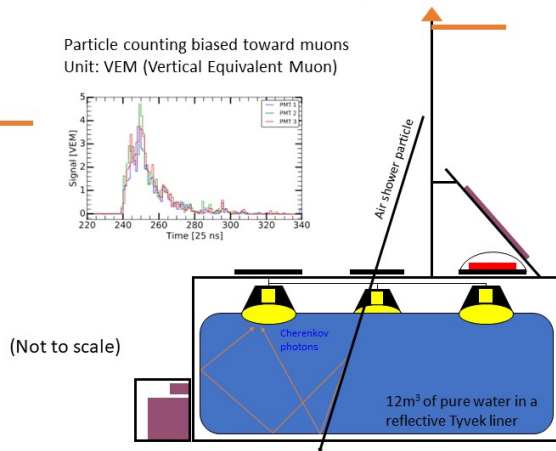
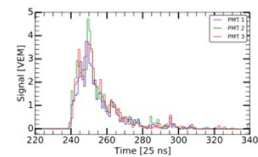
Telescope Array (Utah, USA)

Indiscriminate Particle counter
Unit: MIP (Minimum Ionizing Particle)



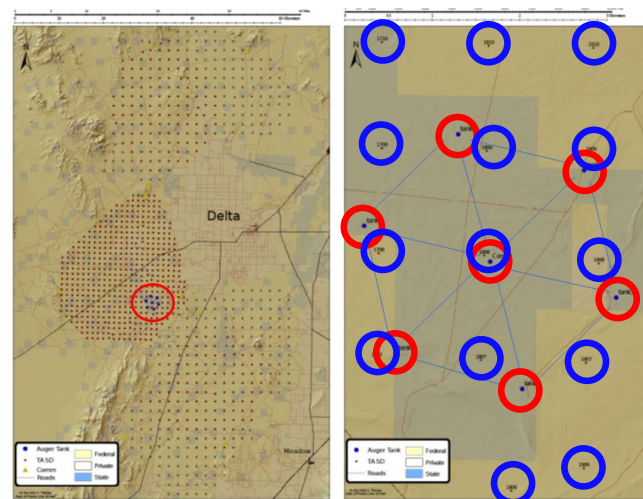
Pierre Auger Observatory (Mendoza Province, Argentina)

Particle counting biased toward muons
Unit: VEM (Vertical Equivalent Muon)



Fred Sarazin (Colorado School of Mines) on behalf ("Auger@TA")

Auger at TA



○ TA Detector
○ AugerDetector

UofU (J. Matthews and S. Thomas) Arranged:

Site at TA selected (close to roads for water delivery)

- A unique site! SITLA land for faster approval procedure than BLM ✓
- Site staking ✓
- Cultural / environmental impact survey ✓
- Lease agreement ✓

Coincident events will allow us to cross-check signals, calibrations, and lateral distributions

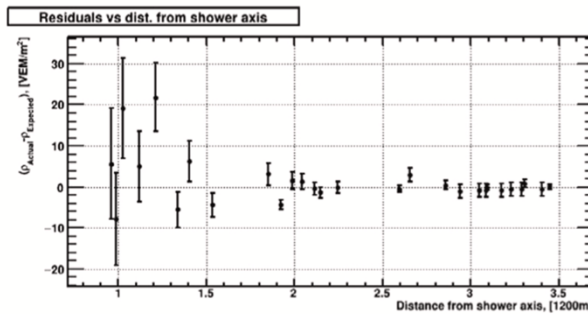
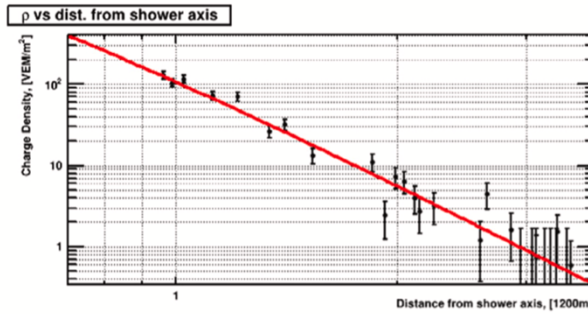
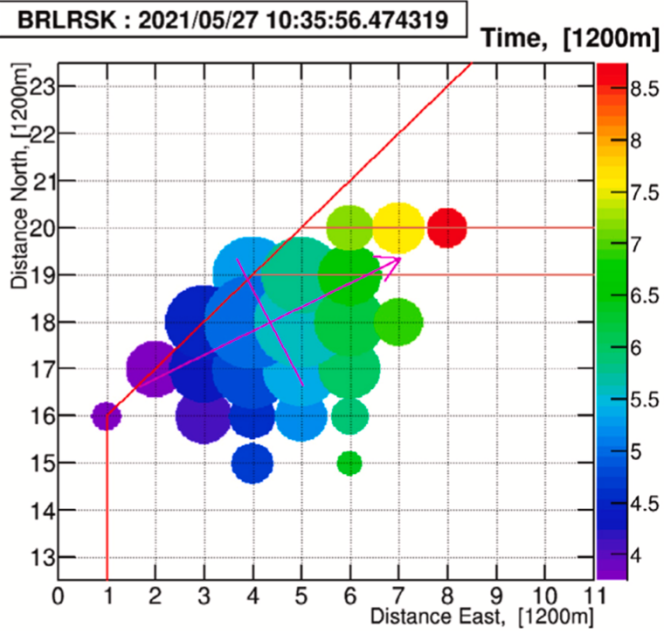
- Perimeter water tanks ("Auger North") have one PMT
- Center has Auger North (1 PMT) + Auger South (3 PMT) + TA SD
- Auger/KIT scintillators are being added to the water tanks – like in Argentina

CENTER TRIPLE OF AUGER@TA – AUGER-N, AUGER-S, TA-SCINT

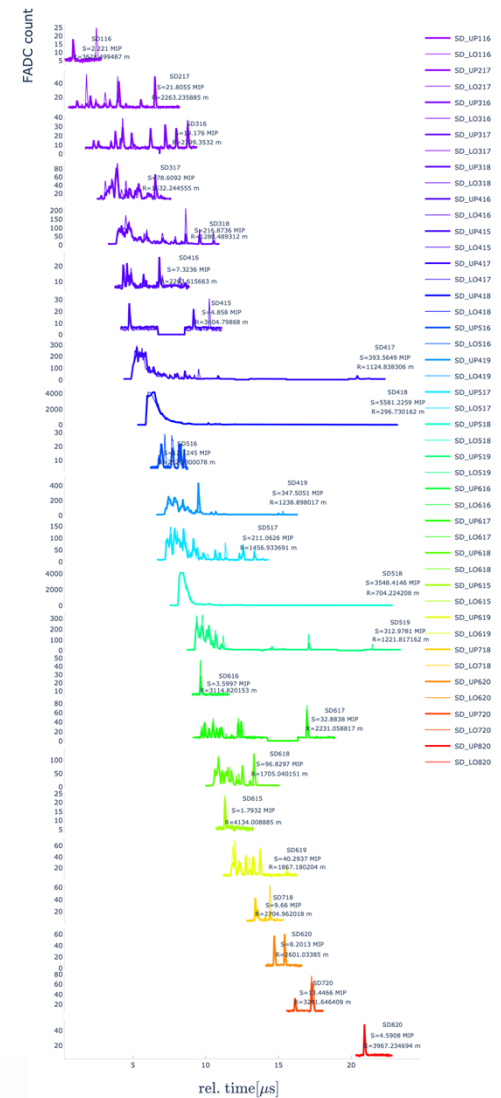


HIGHEST ENERGY EVENT DETECTED BY TELESCOPE ARRAY..... THUS FAR

- 2021-05-27 10:35:56.47, No FD observation
- $E > \sim 240 \text{ EeV}$



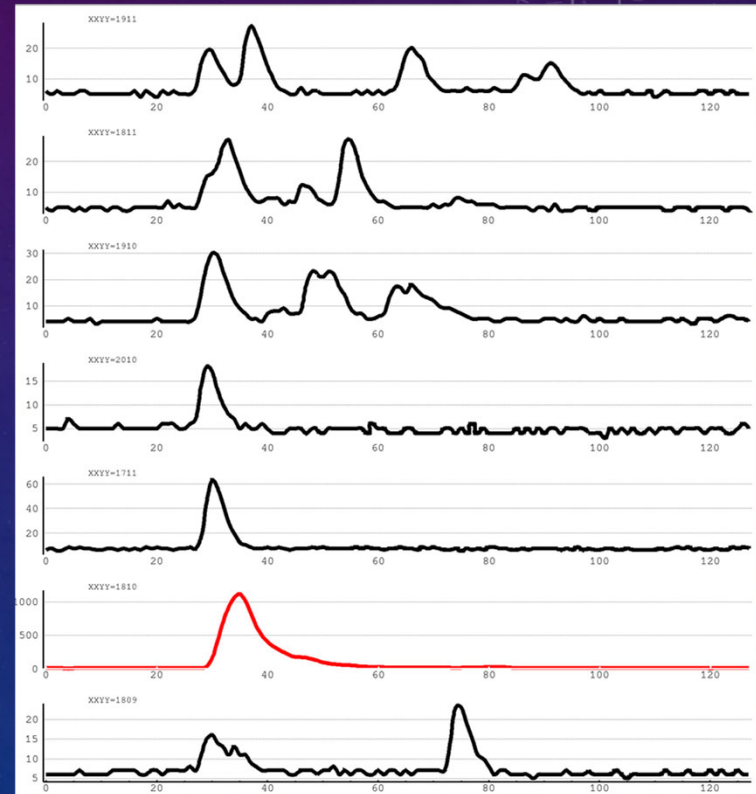
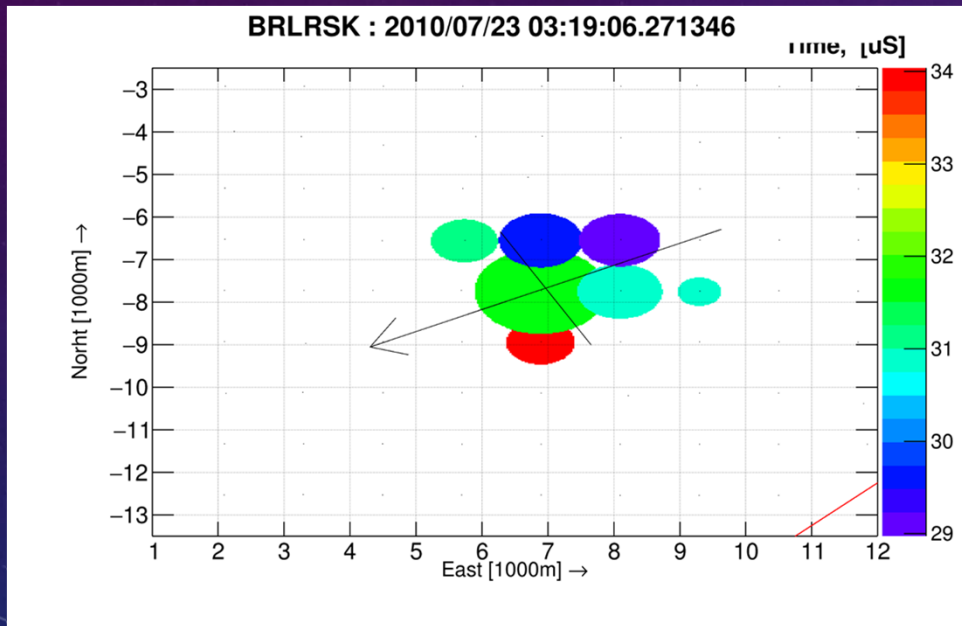
SD event->Date:20210527 Time:103556.474337



I. Fujii et al., Science Nov. 2023

LATERAL DISTRIBUTIONS IN THE SURFACE DETECTORS

$$E = 10^{18.4} \text{ eV}$$



STATUS

- Telescope Array is largely ready
- Waiting for Auger to resolve communications and PMT base issues
- Continued assisting of the Auger team with a variety of tasks
 - Negotiated and maintaining site Lease
 - Surveyed site
 - Coordinated Contractors – making and delivering purified water
 - Periodic checking of detectors, rebooting electronics, fixing antenna, etc
 - Preparing to integrate a TA SD into the Auger Array (E.Kido)
 - Providing a Telescope Array trigger for the Auger Array
 - Preparing analysis of Telescope Array data to compare

